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Adams

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(54) **METHOD AND SYSTEM FOR RE-INVOKING DISPLAYS**

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G06F 9/44 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 9/4443*** (2013.01)

(58) **Field of Classification Search**
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USPC 715/804
See application file for complete search history.

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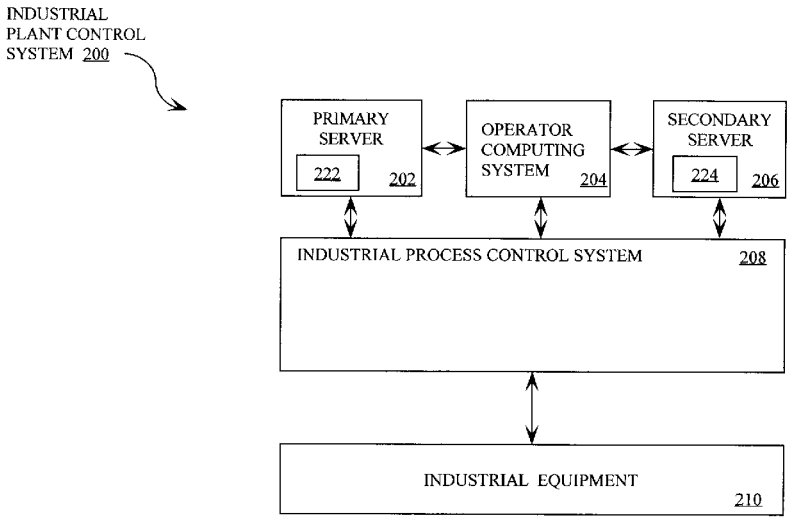
(57) **ABSTRACT**

A method (**600**) for recovering a set of display screen windows (**402**, **404**, **406**, **408**) in a multi-window display screen (**304**). The method involves retaining window information as stored window information (SWI). The SWI includes a first arrangement for a first set of display screen windows (DSWs) displayed on the multi-window display screen at a first time. Each of the DSWs has respective content (**420**, **422**, **424**, **426**). The method also involves using the SWI for redisplaying the first set of display screen windows in the first arrangement on the multi-window display at a second time. The second time is after the first time and follows an event causing the first set of display screen windows to be removed from the multi-window display screen. The redisplayed DSWs contain at least a portion of the respective content.

4 Claims, 6 Drawing Sheets



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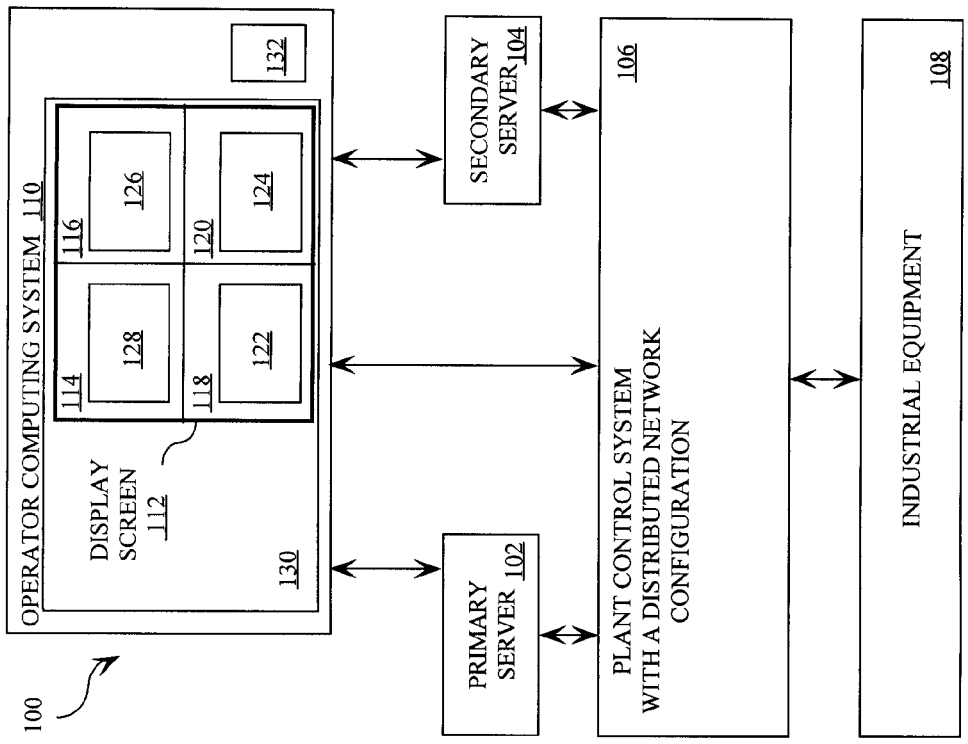

FIG. 1A
(PRIOR ART)

FIG. 1B
(PRIOR ART)

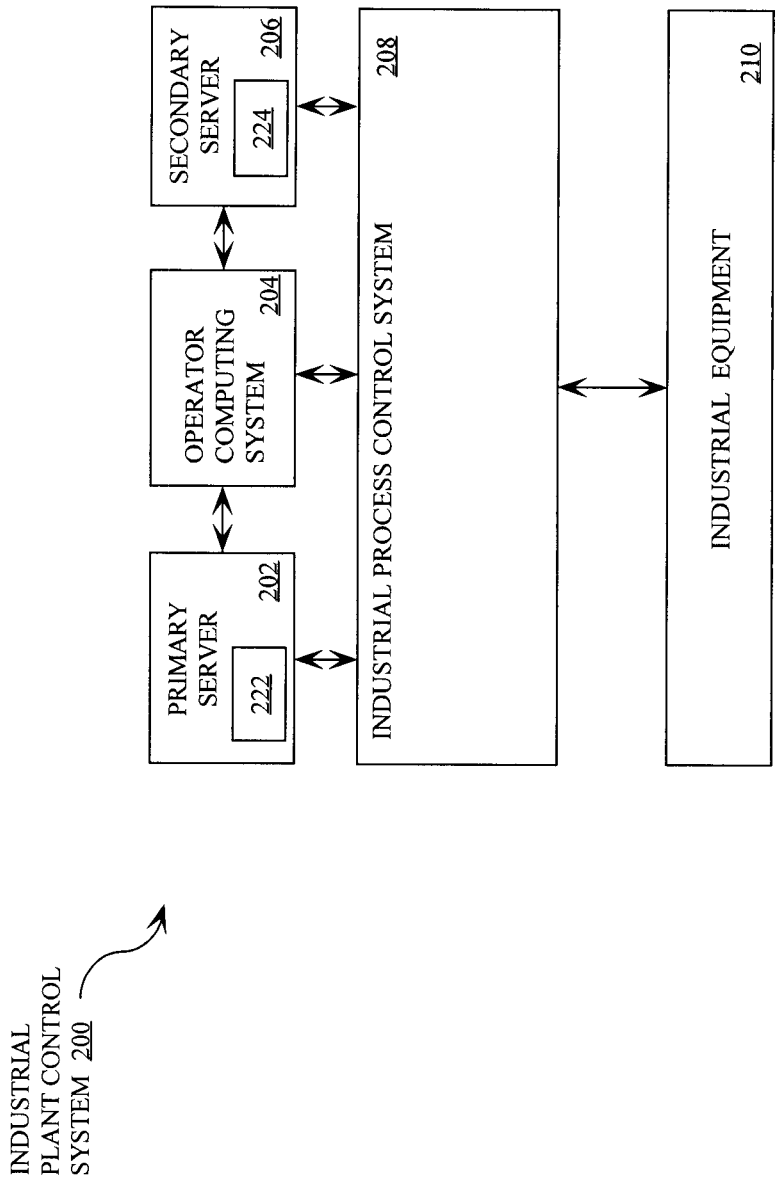
INDUSTRIAL PLANT CONTROL SYSTEM 200
PRIMARY SERVER 202
222
OPERATOR COMPUTING SYSTEM 204
SECONDARY SERVER 206
224
INDUSTRIAL PROCESS CONTROL SYSTEM 208
INDUSTRIAL EQUIPMENT 210

FIG. 2

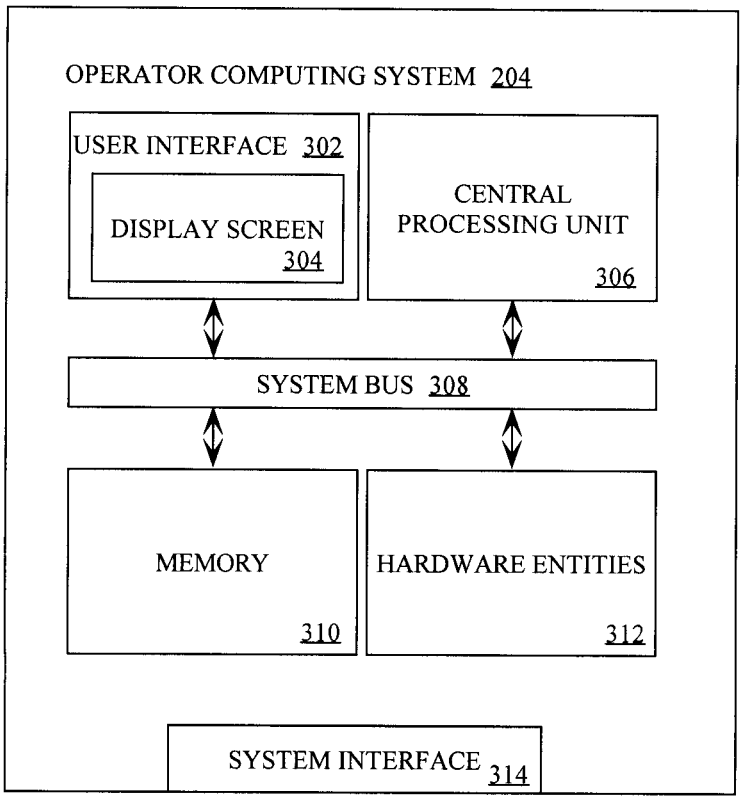
OPERATOR COMPUTING SYSTEM 204
USER INTERFACE 302
DISPLAY SCREEN 304
CENTRAL PROCESSING UNIT 306
SYSTEM BUS 308
MEMORY 310
HARDWARE ENTITIES 312
SYSTEM INTERFACE 314

FIG. 3

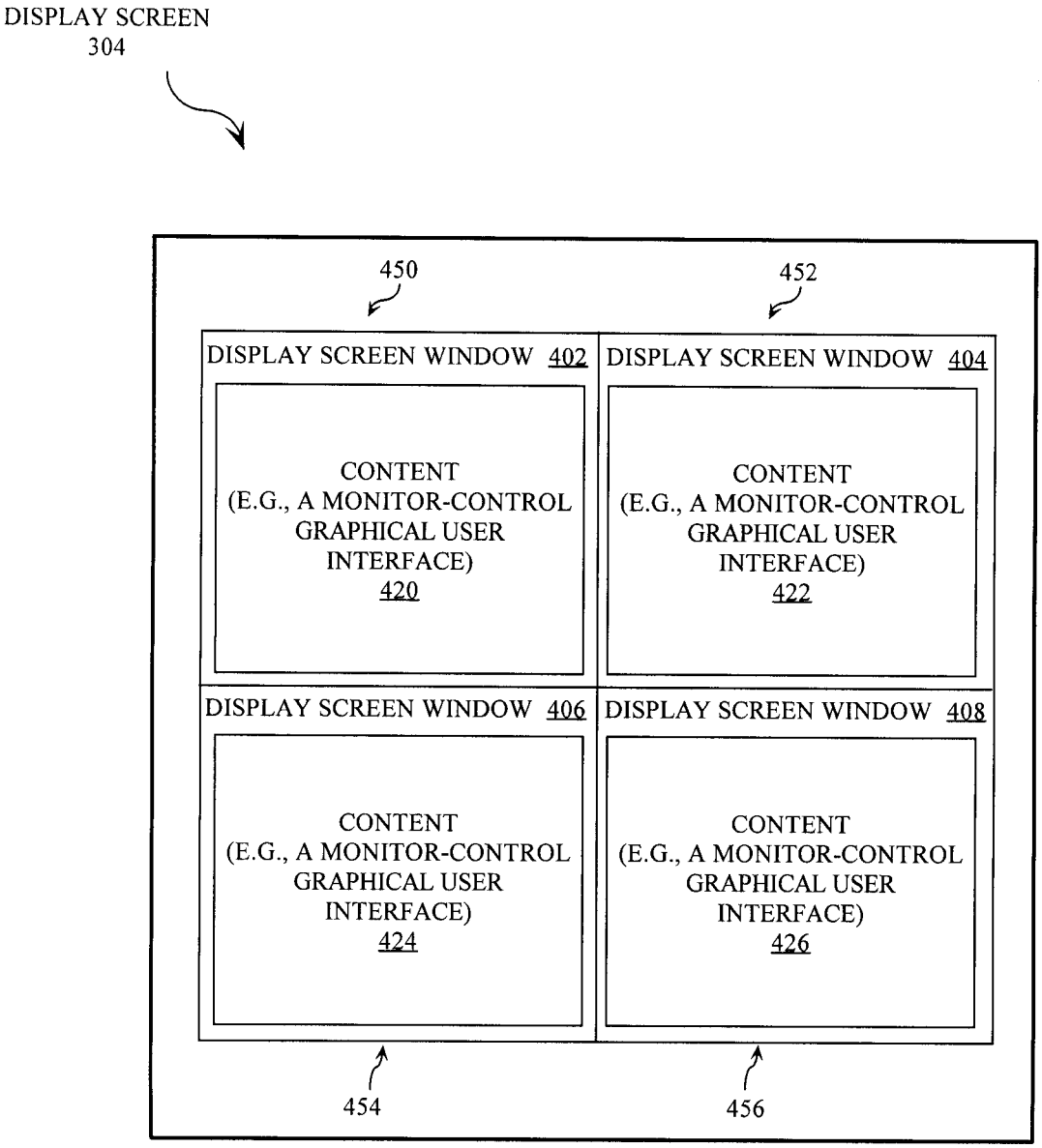
DISPLAY SCREEN
304
450
452
DISPLAY SCREEN WINDOW 402
DISPLAY SCREEN WINDOW 404
CONTENT
(E.G., A MONITOR-CONTROL
GRAPHICAL USER
INTERFACE)
420
CONTENT
(E.G., A MONITOR-CONTROL
GRAPHICAL USER
INTERFACE)
422
DISPLAY SCREEN WINDOW 406
DISPLAY SCREEN WINDOW 408
CONTENT
(E.G., A MONITOR-CONTROL
GRAPHICAL USER
INTERFACE)
424
CONTENT
(E.G., A MONITOR-CONTROL
GRAPHICAL USER
INTERFACE)
426
454
456

FIG. 4

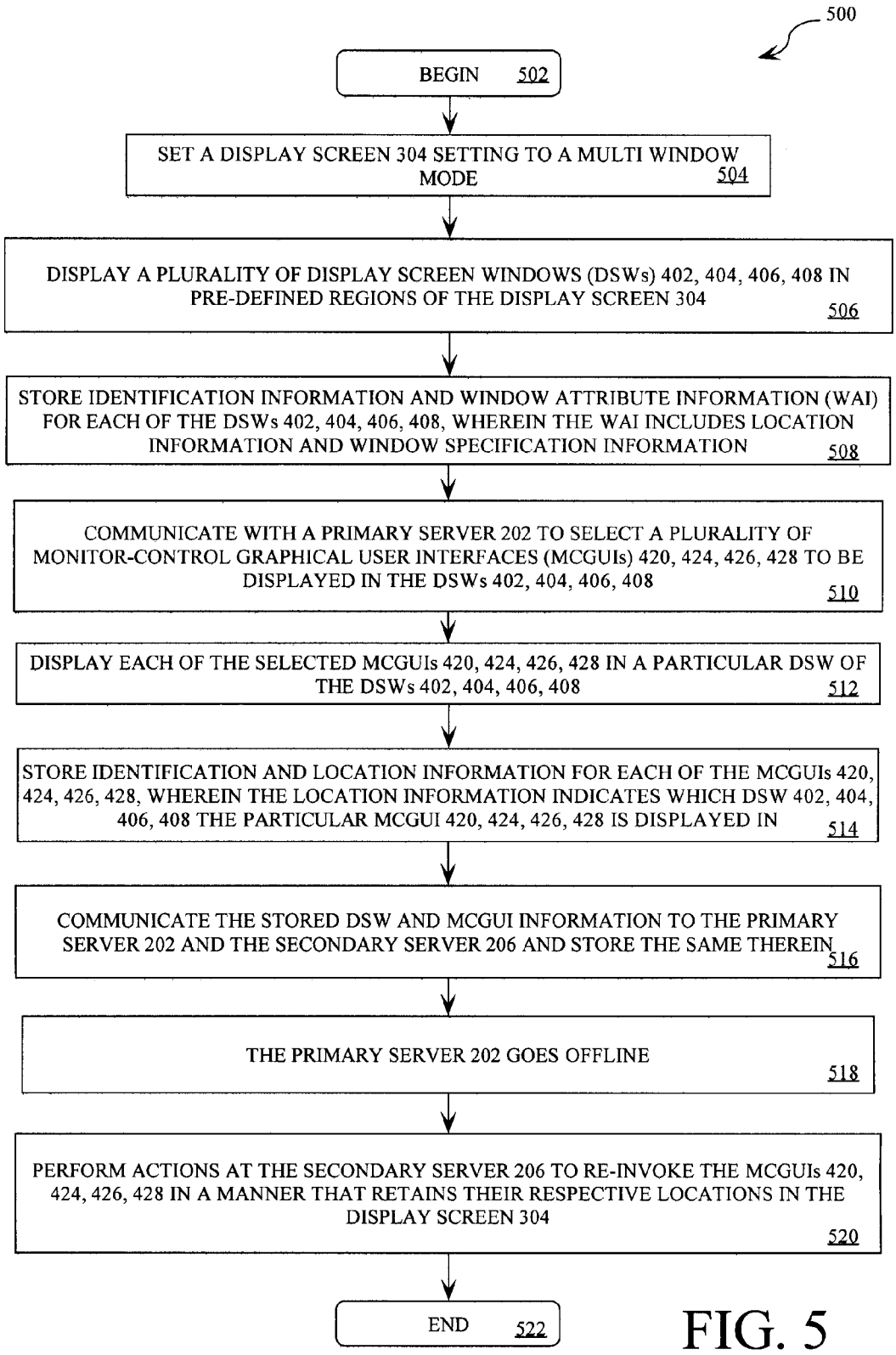
500
BEGIN 502
SET A DISPLAY SCREEN 304 SETTING TO A MULTI WINDOW MODE 504
DISPLAY A PLURALITY OF DISPLAY SCREEN WINDOWS (DSWs) 402, 404, 406, 408 IN PRE-DEFINED REGIONS OF THE DISPLAY SCREEN 304 506
STORE IDENTIFICATION INFORMATION AND WINDOW ATTRIBUTE INFORMATION (WAI) FOR EACH OF THE DSWs 402, 404, 406, 408, WHEREIN THE WAI INCLUDES LOCATION INFORMATION AND WINDOW SPECIFICATION INFORMATION 508
COMMUNICATE WITH A PRIMARY SERVER 202 TO SELECT A PLURALITY OF MONITOR-CONTROL GRAPHICAL USER INTERFACES (MCGUIs) 420, 424, 426, 428 TO BE DISPLAYED IN THE DSWs 402, 404, 406, 408 510
DISPLAY EACH OF THE SELECTED MCGUIs 420, 424, 426, 428 IN A PARTICULAR DSW OF THE DSWs 402, 404, 406, 408 512
STORE IDENTIFICATION AND LOCATION INFORMATION FOR EACH OF THE MCGUIs 420, 424, 426, 428, WHEREIN THE LOCATION INFORMATION INDICATES WHICH DSW 402, 404, 406, 408 THE PARTICULAR MCGUI 420, 424, 426, 428 IS DISPLAYED IN 514
COMMUNICATE THE STORED DSW AND MCGUI INFORMATION TO THE PRIMARY SERVER 202 AND THE SECONDARY SERVER 206 AND STORE THE SAME THEREIN 516
THE PRIMARY SERVER 202 GOES OFFLINE 518
PERFORM ACTIONS AT THE SECONDARY SERVER 206 TO RE-INVOKE THE MCGUIs 420, 424, 426, 428 IN A MANNER THAT RETAINS THEIR RESPECTIVE LOCATIONS IN THE DISPLAY SCREEN 304 520
END 522

FIG. 5

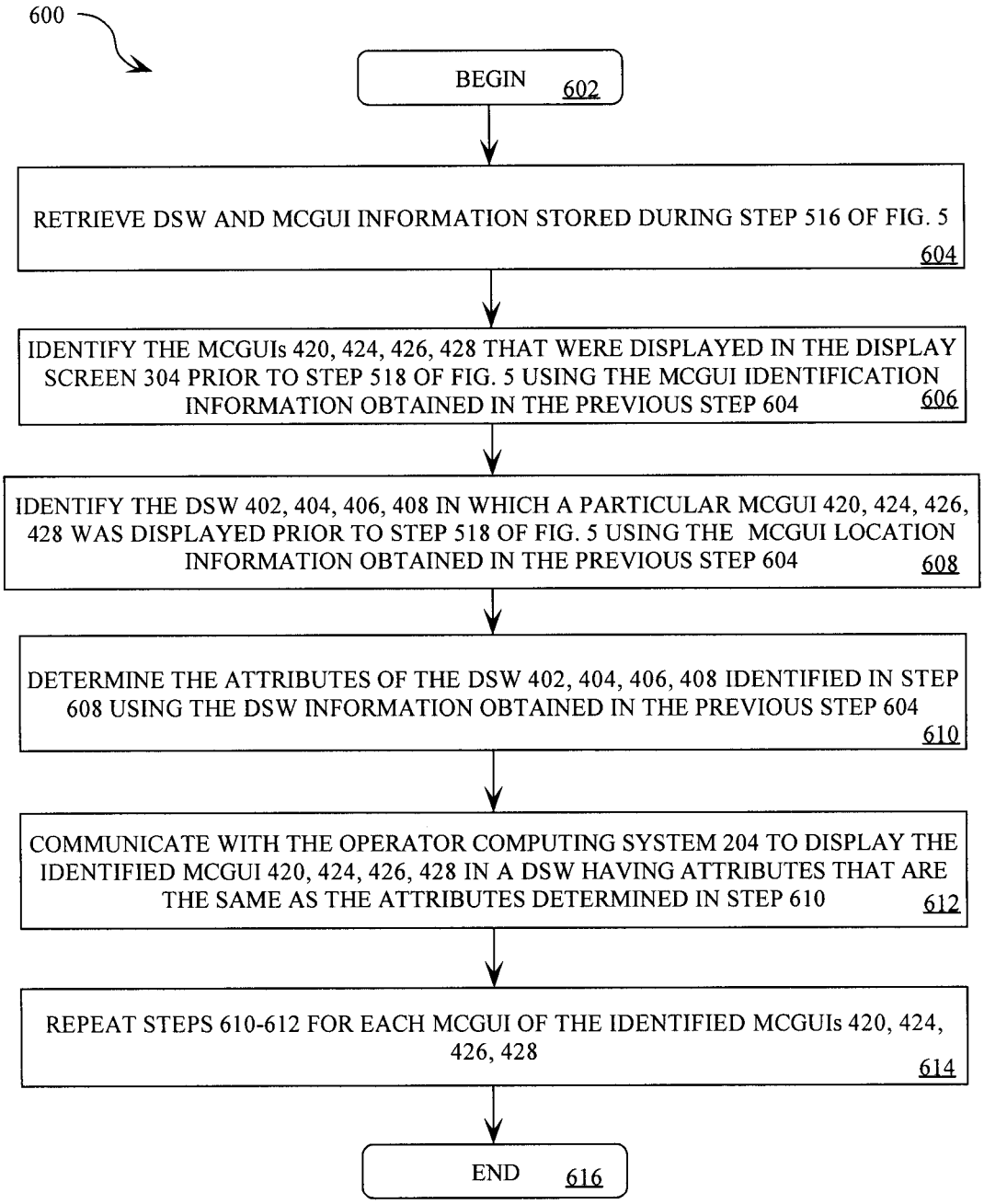
600
BEGIN 602
RETRIEVE DSW AND MCGUI INFORMATION STORED DURING STEP 516 OF FIG. 5 604
IDENTIFY THE MCGUIs 420, 424, 426, 428 THAT WERE DISPLAYED IN THE DISPLAY SCREEN 304 PRIOR TO STEP 518 OF FIG. 5 USING THE MCGUI IDENTIFICATION INFORMATION OBTAINED IN THE PREVIOUS STEP 604 606
IDENTIFY THE DSW 402, 404, 406, 408 IN WHICH A PARTICULAR MCGUI 420, 424, 426, 428 WAS DISPLAYED PRIOR TO STEP 518 OF FIG. 5 USING THE MCGUI LOCATION INFORMATION OBTAINED IN THE PREVIOUS STEP 604 608
DETERMINE THE ATTRIBUTES OF THE DSW 402, 404, 406, 408 IDENTIFIED IN STEP 608 USING THE DSW INFORMATION OBTAINED IN THE PREVIOUS STEP 604 610
COMMUNICATE WITH THE OPERATOR COMPUTING SYSTEM 204 TO DISPLAY THE IDENTIFIED MCGUI 420, 424, 426, 428 IN A DSW HAVING ATTRIBUTES THAT ARE THE SAME AS THE ATTRIBUTES DETERMINED IN STEP 610 612
REPEAT STEPS 610-612 FOR EACH MCGUI OF THE IDENTIFIED MCGUIs 420, 424, 426, 428 614
END 616

FIG. 6

METHOD AND SYSTEM FOR RE-INVOKING DISPLAYS

FIELD OF THE INVENTION

The invention concerns display systems and methods for recovering display information.

BACKGROUND

There are many types of industrial plant control systems (IPCS) known in the art for controlling industrial equipment and processes. One such conventional IPCS **100** is shown in FIG. **1**A. As shown in FIG. **1**A, the IPCS **100** includes a primary server **102**, an operator computing system **110**, a secondary (or back-up) server **104**, a plant control system **106**, and industrial equipment **108**. The plant control system **106** has a distributed network configuration, i.e., there are application specific modules connected to each other, industrial equipment, and operator interfaces via a local control network.

Each of the components **102**, **110**, **106**, **108** is well known to those having ordinary skill in the art, and therefore will not be described in detail herein. However, it should be understood that the operator computing system **110** is configured to enable the control of the industrial equipment **108** by an operator (not shown). As such, the operator computing system **110** includes a user interface **130** and a processing device **132**. The user interface **130** is often comprised of a keyboard (not shown), a mouse (not shown), a display screen **112**, and the like. The display screen **112** and processing device **132** collectively display a set of display windows **114**, **116**, **118**, **120** to the operator (not shown). The phrase "display window" as used herein refers to a visual area of the display screen **112** configured to display at least one graphical user interface (GUI). GUIs are well known to those skilled in the art, and therefore will not be described herein.

If the primary server **102** is online, then the primary server **102** provides a means to select a plurality of monitor-control graphical user interfaces (MCGUIs) **122**, **124**, **126**, **128** to be displayed in the display windows **114**, **116**, **118**, **120**. The phrase "monitor-control graphical user interface" as used herein refers to a graphical user interface which displays information and generally provides command control for monitoring and/or controlling applications, such as for an industrial process or industrial equipment. Alternatively, if the primary server **102** is offline and the secondary server **104** is online, then the secondary server **104** performs actions to select a plurality of monitor-control graphical user interfaces (MCGUIs) **122**, **124**, **126**, **128** to be displayed in the display windows **114**, **116**, **118**, **120**.

The MCGUIs **122**, **124**, **126**, **128** typically include a text display area (not shown), a video display area (not shown), an image display area (not shown), command buttons (not shown), scroll bars (not shown), and/or the like. Each of the MCGUIs **122**, **124**, **126**, **128** is displayed in a particular display window **114**, **116**, **118**, **120**. For example, an MCGUI **122** is displayed in the display window **114**. Similarly, the MCGUI **124** is displayed in the display window **116**. Likewise, the MCGUI **126** is displayed in the display window **118**. The MCGUI **128** is displayed in the display window **120**. However, it should be understood that more than one GUI can be displayed in each of the display windows **114**, **116**, **118**, **120**.

Despite certain advantages of such a conventional IPCS **100**, it suffers from certain drawbacks. For example, if the primary server **102** fails, then the secondary server **104** performs a re-set process to re-set the MCGUIs **122**, **124**, **126**, **128**. During this re-set process, the display windows **114**, **116**, **118**, **120** are shut-down and each of the MCGUIs **122**, **124**, **126**, **128** is re-invoked. As a result of the re-invocation process, the MCGUIs **122**, **124**, **126**, **128** reappear in a random order on the display screen **112** as shown in FIG. **1**B. Stated differently, each of the MCGUIs **122**, **124**, **126**, **128** reappears in a respective display window that is generally different from the previous arrangement of GUIs in the previous respective display window. One can appreciate that the randomly ordered MCGUIs **122**, **124**, **126**, **128** may result in operator confusion. The randomly ordered MCGUIs **122**, **124**, **126**, **128** may also result in improper operator actions that can cause a failure of an industrial process or an abnormality in the industrial process.

SUMMARY

This Summary is provided to comply with 37 C.F.R. §1.73, requiring a summary of the invention briefly indicating the nature and substance of the invention. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims.

The present invention concerns methods and related implementing systems for recovering a set of display screen windows in a multi-window display screen. The methods generally involve retaining stored window information. The window information comprises a first arrangement for a first set of display screen windows displayed on a multi-window display screen at a first time. Each of the display screen windows has respective content. The methods also involve using the stored window information for redisplaying the first set of display screen windows in the first arrangement on the multi-window display at a second time after the first time. The second time follows an event (e.g., loss of power) causing the first set of display screen windows to be removed from the multi-window display screen. The redisplayed display screen windows contain at least a portion of the respective content.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments will be described with reference to the following drawing figures, in which like numerals represent like items throughout the figures, and in which:

FIG. **1**A is a block diagram of a conventional industrial plant control system having a display screen with window displays and monitor-control graphical user interfaces displayed in a first arrangement.

FIG. **1**B is a block diagram of a conventional industrial plant control system having a display screen with window displays and monitor-control graphical user interfaces displayed in a second arrangement different from the first arrangement of FIG. **1**A.

FIG. **2** is a block diagram of an industrial plant control system including an operator computing system according to an embodiment of the invention.

FIG. **3** is a more detailed block diagram of the operator computer system shown in FIG. **2**.

FIG. **4** is a schematic illustration of the display screen of FIG. **3** having a plurality of display windows and monitor-control graphical user interfaces displayed therein.

FIG. **5** is a flow diagram of method for displaying display windows and monitor-control graphical user interfaces in a display screen according to an embodiment of the invention.

FIG. **6** is a flow diagram of a re-invocation process described in FIG. **5**.

DETAILED DESCRIPTION OF THE DRAWINGS

Embodiments of the invention provide methods and related implementing systems for re-invoking a set of graphical user interfaces in a manner that retains their original positions in a display screen. The invention will now be described more fully hereinafter with reference to accompanying drawings, in which illustrative embodiments of the invention are shown. This invention, may however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. For example, the present invention can be embodied as a method, a data processing system, or a computer program product. Accordingly, the present invention can take the form as an entirely hardware embodiment, an entirely software embodiment, or a hardware/software embodiment.

Before describing method embodiments of the present invention, it will be helpful in understanding an exemplary environment in which the methods can be utilized. In this regard, it should be understood that the methods of the present invention can be utilized in any application where an operator monitors multiple display screen windows. Such applications include, but are not limited to, industrial plant control applications, medical applications, security applications, and navigation applications. Accordingly, methods of the present invention will now be described in relation to one particular application, namely, the industrial plant control application.

Referring now to FIG. **2**, there is provided a block diagram of an exemplary industrial plant control system **200** according to an embodiment of the invention. As shown in FIG. **2**, the control system **200** comprises a primary server **202**, an operator computing system **204**, a secondary server **206**, an industrial process control system (IPCS) **208**, and industrial equipment **210**. Servers **202**, **206** are well known to those skilled in the art, and therefore will not be described in detail herein. However, it should be understood that the primary server **202** is configured to perform application specific actions for controlling an industrial process and equipment. As known in the art, if the primary server **202** is manually taken offline or fails, then the secondary server **206** takes over and begins performing application specific actions for controlling an industrial process and equipment. As should be understood, the primary server **202** can be manually taken offline for maintenance and/or component replacement. The primary server **202** can fail as a result of unintentional events, such as a power surge, a power loss, a system crash, application crash, or a component failure.

Referring again to FIG. **2**, the servers **202**, **206** and the IPCS **208** collectively control an industrial process and equipment **210**. In one non-limiting application, the IPCS **208** can be the control system described in U.S. Pat. No. 5,796,403 and U.S. Pat. No. 5,734,380. In such a scenario, the IPCS **208** is generally a distributed control system, i.e., there are application specific modules connected to each other, industrial equipment, and operator interfaces via a local control network. The industrial equipment **210** may include, but are not limited to, gauges, valves, transmitters, actuators, and sensors. The invention is not limited in this regard.

As shown in FIG. **2**, each of the servers **202**, **206** is configured to communicate with the operator computing system **204** for displaying monitor and/or control information to an operator (not shown). The term "operator" as used herein refers to one or more users of the operator computing system **204**. In this regard, it should be understood that the servers **202**, **206** can be configured to receive information from the operator computing system **204** and/or the industrial process control system **208**. Such information generally includes, but is not limited to, display screen window identification information (described below in relation to FIG. **3**), display screen window attribute information (described below in relation to FIG. **3**), monitor-control graphical user interface identification information (describe below in relation to FIG. **3**), and monitor-control graphical user interface location information (describe below in relation to FIG. **3**). Each of the servers **202**, **206** is generally comprised of a memory device **222**, **224** for storing the received information.

The operator computing system **204** may be a desktop personal computer system, a laptop personal computer system, a personal digital assistant, a mobile computing device, or any other general purpose computer processing device. Accordingly, the operator computing system **204** is configured to display content in display screen windows. The phrase "display screen window" as used herein refers to a visual area of a display screen containing content. Such content can include, but is not limited to, still images, video images, an animated image, text, graphs, charts, data, graphical user interfaces (GUIs), or any other information useful in monitoring an area of interest and/or controlling a desired process. In the industrial process scenario, the GUIs can contain information necessary for enabling an operator (not shown) to monitor and/or control an industrial process or equipment. Such information includes, but is not limited to, real-time images of industrial equipment (e.g., a tank filled with a liquid), data indicating temperature of a particular area of an industrial plant, data indicating temperature of a liquid used in an industrial process, and data indicating how much liquid is in a particular container.

Referring now to FIG. **3**, there is provided a more detailed block diagram of the operator computer system **204** of FIG. **2**. As shown in FIG. **3**, the operator computer system **204** is comprised of a system interface **314**, a user interface **302**, a central processing unit **306**, a system bus **308**, a memory **310** connected to and accessible by other portions of the operator computer system **204** through the system bus **308**, and hardware entities **312** connected to the system bus **308**. At least some of the hardware entities **312** perform actions involving access to and use of the memory **310**, which for example may be a random access memory (RAM), a disk driver, and/or a compact disc read only memory (CD-ROM).

The hardware entities **312** may include microprocessors, application specific integrated circuits (ASICs), or other hardware. The hardware entities **312** may include a microprocessor programmed for communicating with a primary and secondary server **202**, **206**. More particularly, the hardware entities **312** may include a microprocessor programmed for communicating display screen window (DSW) identification and attribute information to the primary and secondary server **202**, **206**. Such DSW identification information generally includes, but is not limited to, a unique string of letters or numbers associated with a particular DSW (described below in relation to FIG. **4**). Such DSW attribute information can include, but is not limited to, DSW location information and DSW specification information. The DSW location information indicates a pre-defined region of a display screen in which a particular DSW (described below in relation to FIG. **4**) exists prior to a system failure. The DSW attribute information can include, but is not limited to, (a) information indicating whether a particular DSW can be resized by an operator, (b) information indicating whether a particular DSW can be closed, (c) information indicating whether a particular DSW can be minimized, and/or (d) information indicating whether a particular DSW remains visible even when its territory overlaps another DSW.

The hardware entities **312** may also include a microprocessor programmed for communicating DSW content information to the primary and secondary server **202**, **206**. For example, if the DSW content is a monitor-control graphical user interface (MCGUI), then the microprocessor can be programmed for communicating monitor-control graphical user interface (MCGUI) identification and location information to the primary and secondary server **202**, **206**. As stated above, the phrase "monitor-control graphical user interface" as used herein refers to a graphical user interface which displays information and generally provides command control for monitoring and/or controlling applications, such as for an industrial process or industrial equipment. Such MCGUI identification information can include, but is not limited to, a unique string of letter or numbers associated with a particular MCGUI (described below in relation to FIG. **4**). Such MCGUI location information can indicate which DSW (described below in relation to FIG. **4**) a particular MCGUI (described below in relation to FIG. **4**) is displayed in prior to a system failure. The hardware entities **312** may further include a microprocessor programmed for communicating with the primary and secondary server **202**, **206** for selecting one or more MCGUIs (described below in relation to FIG. **4**) to be displayed in each of the DSWs (described below in relation to FIG. **4**).

The user interface **302** is generally comprised of input devices, output devices, and software routines configured to allow a user to interact with and control software applications installed on the operator computer system **204**. Such input and output devices include, but are not limited to, a display screen **304**, a speaker (not shown), a keypad (not shown), a directional pad (not shown), a directional knob (not shown), and a microphone (not shown). As such, the user interface **302** can facilitate a user-software interaction for communicating with the primary and second servers **202**, **206**. The user interface **302** can also facilitate a user-software interaction for selecting a mode for the display screen **304**, such as a single window mode or a multi-window mode. In the single window mode, a single DSW is displayed in a pre-defined region of the display screen **304**. In the multi-window mode, two or more DSWs are displayed in pre-defined regions of the display screen **304**. It should be well known to those skilled in the art that a display screen **304** may be comprised of either a single physical device, or multiple physical devices, such as cathode ray tubes (CRTs) or liquid crystal displays (LCDs) or other similar such devices. The user interface **302** can further facilitate a user-software interaction for selecting desired content to be displayed in one or more DSWs (described below in relation to FIG. **4**).

The system interface **314** allows the operator computer system **204** to communicate directly or indirectly with the primary and secondary servers **202**, **206**. If the operator computer system **204** is communicating indirectly with the servers **202**, **206**, then the operator computer system **204** is sending and receiving communications through a network (not shown). For example, the network (not shown) can be a wireless network such as a local area network, a wide area network, or a personal area network.

Referring now to FIG. **4**, there is provided a schematic illustration of the display screen **304** of FIG. **3** having four (4) DSWs **402**, **404**, **406**, **408** and four (4) MCGUIs **420**, **422**, **424**, **426** displayed therein. The invention is not limited in this regard. The display screen **304** can have any number N of DSWs displayed therein, wherein N is selected in accordance with a particular display screen **304** application. Also, although FIG. **4** shows one MCGUI per DSW, each of the DSWs can contain more than one MCGUI. Furthermore, each of the DSWs can include content other than MCGUIs, such as still images, video images, an animated image, text, graphs, charts, and data useful in monitoring an area of interest, and data useful in controlling a desired process.

As shown in FIG. **4**, each of the DSWs **402**, **404**, **406**, **408** exists in a pre-defined area (or region) **450**, **452**, **454**, **456** of the display screen **304**. For example, the DSW **402** exists in the upper left area (or region) **450** of the display screen **304**. Similarly, the DSW **404** exists in the upper right area (or region) **452** of the display screen **304**. Likewise, the DSW **406** exists in the lower left area (or region) **454** of the display screen **304**. DSW **408** exists in the lower right area (or region) **456** of the display screen **304**. However, the invention is not limited in this regard. The DSWs **402**, **404**, **406**, **408** can exist in any pre-defined area (or region) selected in accordance with a particular display screen **304** application, and be in general any total number.

As shown in FIG. **4**, each of the DSWs **402**, **404**, **406**, **408** contains certain content. For example, if the content is selected to include MCGUIs, then the DSW **402** may contain the MCGUI **420**. Similarly, the DSW **404** may contain the MCGUI **422**. Likewise, the DSWs **406**, **408** may contain the MCGUIs **424**, **426**, respectively.

FIGS. **5-6** and accompanying text described below illustrate an exemplary method **500** according to an embodiment of the invention. The method **500** is provided for (a) displaying display screen windows (DSWs) and graphical user interfaces (GUIs) in a display screen and (b) re-invoking the GUIs in a manner that retains their original display screen arrangement. It should be appreciated, however, that the method disclosed herein is provided for purposes of illustration only and that the present invention is not limited solely to the particular method shown. For example, as described above, there can be more than one MCGUI per DSW.

Referring now to FIG. **5**, the method **500** begins at step **502** and continues with step **504**. In step **504**, an operator performs actions to set a display screen **304** setting to a multi-window mode. Such operator actions can be achieved utilizing the user interface **302** of the operator computer system **204**. Subsequently, the method **500** continues with step **506**. In step **506**, two or more DSWs **402**, **404**, **406**, **408** are displayed in pre-defined regions of the display screen **304**. Thereafter, step **508** is performed where identification and attribute information for each DSW is retained as stored window information. The attribute information can include, but is not limited to, DSW location information and DSW specification information. The DSW location information indicates a pre-defined region (e.g., upper left) of a display screen **304** in which a particular DSW exists prior to a system failure. The DSW attribute information can include information indicating whether a particular DSW always exists in an upper region of the display screen, information indicating whether a particular DSW can be closed, information indicating whether a particular DSW can be minimized, or other attribute information.

After step **508**, the method **500** continues with step **510**. In step **510**, the operator computer system **204** performs actions to communicate with a primary server to select two or more MCGUIs **420**, **424**, **426**, **428** to be displayed in the DSWs **402**, **404**, **406**, **408**. Such actions can generally include generating messages, sending generated messages to the primary server, receiving messages from the primary server, processing received messages to obtain data therefrom, and displaying the data (e.g., a set of MCGUIs) to an operator. As should be understood, the computer system actions can be performed in response to an operator (not shown) action. Thereafter, step **512** is performed where each of the selected MCGUIs **420**,

424, 426, 428 is displayed in a particular DSW 402, 404, 406, 408. In step 514, identification and location information for each MCGUI 420, 424, 426, 428 is retained as stored window information, such as in the memory device 310 of the operator computer system 204. The MCGUI location information can indicate which DSW 402, 404, 406, 408 the particular MCGUI 420, 424, 426, 428 is displayed in. Subsequently, step 516 is performed where the DSW and MCGUI information are communicated, such as from the operator computer system 204 to a primary and secondary server, such as the primary and secondary servers 202, 206. In this regard, it should be understood that the information can be communicated to a primary server for purposes of maintaining a historical list of the content displayed to an operator. At the primary and secondary server 202, 206, the received information can be stored in the memory devices 222, 224, respectively.

After step 516, the method 500 continues with step 518. In step 518, the primary server 202 unintentionally goes offline or is intentionally taken offline. The term "offline" as used herein means that a computing device is not connected or available to another computing device or network. For example, if the primary server 202 needs maintenance, then the primary server 202 may be intentionally taken offline. In contrast, if the primary server 202 fails, then the primary server 202 is unintentionally taken offline. Subsequent to step 518, step 520 is performed.

In step 520, the secondary server 206, which has stored DSW and MCGUI information, performs actions to re-invoke the MCGUIs 420, 424, 426, 428 in a manner that retains their respective previous locations in the display screen 304 that existed prior to the primary server going offline. Stated differently, the prior detailed arrangement and attributes of the DSWs 402, 404, 406, 408 are retained as well as the display screen locations of the MCGUIs 420, 424, 426, 428. As such, the MCGUIs 420, 424, 426, 428 can be re-displayed to an operator (not shown) in a configuration that is based on the former configuration (i.e., the display screen configuration presented prior to step 518). The conventional system drawback (described in relation to FIGS. 1A-1B) of a re-invocation process resulting in randomly ordered display screen content (e.g., MCGUIs) is thus overcome. A process for re-invoking the MCGUI 420, 424, 426, 428 will be described below in relation to FIG. 6. Upon re-invoking the MCGUI 420, 424, 426, 428, step 522 is performed where the method 500 ends.

Referring now to FIG. 6, there is provided a flow diagram of a re-invocation process 600 performed in step 520 of FIG. 5. As shown in FIG. 6, the re-invocation process 600 begins at step 602 and continues with step 604. In step 604, the secondary server 206 performs actions to access its internal memory 224. The secondary server 206 also performs actions to retrieve DSW and MCGUI information from its internal memory 224. It should be noted that the DSW and MCGUI information retrieved in step 604 is the same DSW and MCGUI information stored in the memory 224 during step 516 of FIG. 5.

In step 606, MCGUIs 420, 424, 426, 428 are identified. Notably, the identified MCGUIs 420, 424, 426, 428 are the MCGUIs that were displayed in the display screen 304 prior to step 518 of FIG. 5. This MCGUI identification can be provided using the MCGUI identification information obtained in the previous step 604. Subsequent to completing step 606, step 608 is performed where an identification is made. More particularly, the DSW 402, 404, 406, 408 in which a particular MCGUI 420, 424, 426, 428 was displayed in prior to step 518 of FIG. 5 is identified. This identification can be made using the MCGUI location information obtained in the previous step 604. Thereafter, step 610 is performed where the attributes of the DSW 402, 404, 406, 408 identified in step 608 are determined. This attribute determination is made using the DSW attribute information obtained in the previous step 604. The attribute information can include, but is not limited to, information indicating a location, size, and behavioral characteristic of the DSW 402, 404, 406, 408. Such behavioral characteristics include, but are not limited to, closable characteristic, a minimizable characteristic, a maximizable characteristic, a draggable (or movable) characteristic, and a resizable characteristic.

Upon completing step 610, step 612 is performed. In step 612, the secondary server 206 performs actions to communicate with the operator computer system 204 for displaying the identified MCGUI 420, 424, 426, 428 in accordance with the respective DSW 402, 404, 406, 408. Stated differently, the identified MCGUI 420, 424, 426, 428 is re-displayed in a display screen window of a second set of display screen windows having attributes that are the same as attributes of the identified display screen window. Such attributes include, but are not limited to, location, size, and behavioral characteristics (e.g., closable, minimizable, maximizable, draggable, and resizable). In step 614, steps 610-612 are repeated for each MCGUI of the identified MCGUIs 420, 424, 426, 428. Upon completing step 614, step 616 is performed where the re-invocation process 600 ends.

In light of the forgoing description of the invention, it should be recognized that the present invention can be realized in hardware, software, or a combination of hardware and software. A method for decoding an encoded sequence according to the present invention can be realized in a centralized fashion in one processing system, or in a distributed fashion where different elements are spread across several interconnected processing systems. Any kind of computer system, or other apparatus adapted for carrying out the methods described herein, is suited. A typical combination of hardware and software could be a general purpose computer processor, with a computer program that, when being loaded and executed, controls the computer processor such that it carries out the methods described herein. Of course, an application specific integrated circuit (ASIC), and/or a field programmable gate array (FPGA) could also be used to achieve a similar result.

The present invention can also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which, when loaded in a computer system, is able to carry out these methods. Computer program or application in the present context means any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: (a) conversion to another language, code or notation; (b) reproduction in a different material form. Additionally, the description above is intended by way of example only and is not intended to limit the present invention in any way, except as set forth in the following claims.

All of the apparatus, methods and algorithms disclosed and claimed herein can be made and executed without undue experimentation in light of the present disclosure. While the invention has been described in terms of preferred embodiments, it will be apparent to those of skill in the art that variations may be applied to the apparatus, methods and sequence of steps of the method without departing from the concept, spirit and scope of the invention. More specifically, it will be apparent that certain components may be added to,

combined with, or substituted for the components described herein while the same or similar results would be achieved. All such similar substitutes and modifications apparent to those skilled in the art are deemed to be within the spirit, scope and concept of the invention as defined.

The Abstract of the Disclosure is provided to comply with 37 C.F.R. §1.72(b), requiring an abstract that will allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the following claims.

I claim:

1. A method for recovering content and its arrangement in a set of display screen windows (DSWs) displayed in a plurality of display screens, comprising:

receiving real-time content in a plurality of monitor-control graphical user interfaces (MCGUIs) from a first server over a communications network, wherein the real-time content includes data retrieved from an industrial process;

displaying a first arrangement including the plurality of MCGUIs, including the real-time content, rendered within the set of DSWs displayed across the plurality of display screens;

using a processor programmed for communicating with the first server and a second server, without any user input automatically transmitting first identification information, first location information, specification information, behavioral characteristic information, and MCGUI data for each of the set of DSWs displayed across the plurality of display screens;

wherein the first location information indicates a pre-defined region of each of the set of DSWs prior to a system failure;

wherein the behavioral characteristic information includes information whether each of the set of DSWs is closable, minimizable, maximizable, draggable, resizable or whether the DSW remains visible when it overlaps with another DSW;

wherein the MCGUI data comprises second identification information and second location information for each of the plurality of MCGUIs within each of the set of DSWs;

wherein the second location information in the MCGUI data indicates which DSW in the set of DSWs a particular MCGUI is located and displayed in prior to the system failure as represented in the first arrangement;

detecting the system failure of the first server that unintentionally goes offline or is intentionally taken offline;

shutting down the set of DSWs and the plurality of MCGUIs displayed on the plurality of display screens;

receiving DSW data for each of the set of DSWs comprising the first identification information, the first location information, the specification information and the behavioral characteristic information of each of the set of DSWs and the MCGUI data comprising the second identification information and the second location information for each of the plurality of MCGUIs within each of the set of DSWs from the second server over the communications network; and

re-displaying on the plurality of display screens the plurality of MCGUIs in the set of DSWs in the first arrangement before the system failure of the first server using the DSW data for each of the set of DSWs and the MCGUI data for each of the plurality of MCGUIs within each of the set of DSWs received from the second server.

2. The method according to claim **1**, wherein said real-time content includes at least one of a still image, a video image, an animated image, text, a graph, and a chart.

3. A control system, comprising:

a plurality of display screens; and

a computing device configured for:

receiving real-time content in a plurality of monitor-control graphical user interfaces (MCGUIs) from a first server over a communications network, wherein the real-time content includes data retrieved from an industrial process;

displaying a first arrangement including the plurality of MCGUIs, including the real-time content, rendered within a set of display screen windows (DSWs) displayed in the plurality of display screens;

automatically transmitting without any user input first identification information, first location information, specification information, behavioral characteristic information, and MCGUI data for each of the set of DSWs displayed across the plurality of display screens;

wherein the first location information indicates a pre-defined region of each of the set of DSWs prior to a system failure;

wherein the behavioral characteristic information includes information whether each of the set of DSWs is closable, minimizable, maximizable, draggable, resizable or whether the DSW remains visible when it overlaps with another DSW;

wherein the MCGUI data comprises second identification information and second location information for each of the plurality of MCGUIs within each of the set of DSWs;

wherein the second location information in the MCGUI data indicates which DSW in the set of DSWs a particular MCGUI is located and displayed in prior to the system failure as represented in the first arrangement;

detecting the system failure of the first server that unintentionally goes offline or is intentionally taken offline;

shutting down the set of DSWs and the plurality of MCGUIs displayed on the plurality of display screens;

receiving DSW data for each of the set of DSWs comprising the first identification information, the first location information, the specification information and the behavioral characteristic information of each of the set of DSWs and the MCGUI data comprising the second identification information and the second location information for each of the plurality of MCGUIs within each of the set of DSWs from a second server over the communications network; and

re-displaying on the plurality of display screens the plurality of MCGUIs in the set of DSWs in the first arrangement before the system failure of the first server using the DSW data for each of the set of DSWs and the MCGUI data for each of the plurality of MCGUIs within each of the set of DSWs received from the second server.

4. The control system according to claim **3**, wherein said real-time content includes at least one of a still image, a video image, an animated image, text, a graph, and a chart.

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